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MEETING HUMAN NEEDS THROUGH AGRICULTURAL AND FOOD PRACTICES

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MEETING HUMAN NEEDS THROUGH AGRICULTURAL AND FOOD PRACTICES

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Introduction

1. The application of available scientific and technical knowledge to agricultural and food practices in the less developed regions of the world is urgently needed. It is increasingly recognized that the excessive mortality in such areas, particularly among young children, is due in considerable degree to the effect of malnutrition in lowering their resistance to infection and in many cases death results from malnutrition itself.1/ Evidence has also been obtained that subsequent intellectual performance is retarded by the malnutrition which in most technically underdeveloped areas interferes with the growth and development of preschool children.2/ Furthermore, if people are to have the strength and will to work well in agriculture and industry they must receive adequate nourishment.

2. The improvement of human nutrition on a national scale will usually require greater production and more efficient conservation of food as well as better dietary habits. In most of the highly developed countries the production and conservation of food have improved steadily despite sharp reductions in the land area under cultivation and far fewer people employed directly in agricultural production.

3. For any area there is usually considerable technological information available for direct application, but the suitability of all recommendations must be evaluated in relation to local conditions and, where necessary, modifications made before their use. Many mistakes are made by persons trained outside the region who assume, without actually testing a proposed change, that what works in one area will also be useful in another. On the other hand, adequately trained persons are able to adapt experience in one area to local conditions in a different one.

4. Even when this is done, however, there remain agricultural and food problems in all areas, and particularly in the less developed ones, which require further research and not just adaptation of results obtained elsewhere. Thus a program for improving agricultural production and food use which does not include needed research is incomplete and seriously handicapped.

5. Application of knowledge of better agricultural and food practices is often thought of as requiring only educating or persuading the people who produce, handle, and consume food. This is exceedingly important but so is the dissemination of knowledge among the top levels of administrative and policy-making officials of both governmental and non-governmental organizations. When persons

1/ Scrimshaw, N. S., and Behar, M., Protein malnutrition in young children, Science, 133, 2039-2047 (1961).

2/ Cravioto, J., Robles, B., and Ramos-Galvan, R., Influencia del estado de nutricion sobre el desarrollo del nino en el medio rural de Mexico. Bol. Med. Hosp. Inf. Mex., in press (1962).

in posts of authority are not sufficiently well informed, needed legislation is postponed or defeated; funds are not made available for vital functions; training, research and extension programs are not supported; and policy mistakes are needlessly made. It is only when scientific and technological knowledge is appropriately disseminated throughout a population that its full potential can be achieved.

Improving Food Conservation

6. The factors responsible for the much higher crop yields per unit of comparable land in the United States and other highly developed countries are discussed in other papers. The increases in food production in these countries have tended to obscure the significance of the remarkable improvements which they have also made in the conservation of food. For centuries mankind was dependent for food preservation on a limited number of processes, mainly smoking, drying, salting and to a limited extent the refrigeration offered by caves, wells, cold weather and natural ice. With the development of heat-resistant, hermetically-sealed containers in the 19th Century thermal processing came into widespread use.

7. In the 20th Century mechanical production of ice and later the development of mechanical refrigeration led to the widespread use of cold for the conservation of food during storage and distribution. After very small beginnings before the Second World War, freezing has now come to be a major means of conserving food in the United States, and the most rapidly expanding branch of the food industry during the last decade.

8. Both refrigeration and freezing depend on the widespread availability of mechanical units, but a relatively recent development, the combination of freezing and vacuum drying, results in a product which retains the flavor and physical properties of fresh food when rehydrated. In dry form, it can be stored indefinitely without refrigeration. Although relatively costly, this process has many advantages for food handling in tropical areas, and less expensive vacuum drying without freezing can be applied to certain types of food products without a marked change in their flavor and texture.

9. Also of potential significance to underdeveloped areas is the use of ionizing radiation to extend the life of foods although the early hope of using sterilizing doses of radiation seems impractical because of the resulting nutritional and flavor damage. Experiments are continuing with lower dosages of radiation which have a pasteurizing effect. Antibiotic dips are also being used to extend the shelf life of some products. Other useful chemicals include mold inhibitors, such as the propionates in bread; antioxidants, which delay development of one kind of fat rancidity; emulsifiers, such as the ones used to prevent separation of mayonnaise; bleaching agents, as for flour; thickening agents; and substances to prevent caking of powders.

10. Conservation of food begins with the use of chemicals in the field to prevent losses due to insects, to fungal and viral plant pathogens and even to the premature dropping of fruit. It requires adequate storage facilities to protect food from rodents and insects and may involve the control of temperature and humidity or the application of pesticides or other chemicals. Food conservation measures extend to better ways of packing, shipping and distributing food to the consumer. The extensive use of polyethylene and other synthetic films for everything from reducing the damage to stalks of bananas during shipment to the prepackaging of market vegetables, fruits and even meats has helped greatly to reduce waste. The more rapid transportation of foods by fast refrigerated ships, trains and trucks, and by airplane have all reduced the loss of food between producer and ultimate consumer in the developed countries.

Food Enrichment

11. An important means of extending food supplies or making them more effective in human nutrition is enrichment with one or more essential nutrients.

The addition of potassium iodide to salt initiated in the 1920's in Switzerland and the United States contributed greatly to the elimination of goiter as a public health problem in these countries. Potassium iodate has the advantage of being stable even when added to crude moist salt. It has recently been used for salt iodization on a national scale in a number of technically underdeveloped countries and has brought about striking reductions in the prevalence and severity of endemic goiter. In Guatemala over 90 per cent of the population lived in areas with from 30 to 60 per cent goiter before iodization of salt in that country. In August 1962, approximately two years after the initiation of this preventive measure, the prevalence was found to have dropped to less than 10 per cent in most areas and a maximum of 15 per cent in several border populations with access to some non-iodized contraband salt. Similar results were earlier obtained in the department of Caldas, Columbia as well as in Ohio and Michigan in the United States.

12. The enrichment of wheat flour with thiamine, riboflavin, niacin and iron became widespread in the United States two decades ago and later in Canada; it is one of several factors contributing to the almost complete disappearance of acute vitamin deficiences in North America. The enrichment of refined wheat flour is now required by law in a number of other countries including all of those in Central America. It should be adopted by all countries presently using large quantities of refined wheat flour and by those in which whole grain cereals are gradually being replaced by white flour with its lower vitamin and mineral content.

13. Enrichment of polished rice with a similar combination of vitamins was demonstrated to be an effective means of preventing beriberi in a rice-eating population through mass feeding trials carried out in Bataan, the Philippine Islands, during the years 1948-1950. Most polished rice sold in the U.S. is now enriched and this is required by law in Puerto Rico. Enrichment of wheat flour and rice with all three B-complex vitamins and with calcium and iron costs only a few cents per person per year and is strongly recommended by international health authorities. Much of the corn flour or meal sold in the United States is enriched in the same way. Field trials conducted in Yugoslavia have demonstrated that the procedure will eliminate pellagra in a population suffering from this deficiency as a result of diets consisting mainly of maize.

14. Attention is now being given to the practical aspects of improving protein quantity and quality by economical enrichment procedures. The amino acid, methionine, in synthetic form is already extensively added to animal feeds in the United States to increase their protein efficiency, and the addition of lysine to wheat flour or bread has been demonstrated to raise the proportion of utilizable protein from one-half to nearly two-thirds. When threonine becomes available at low cost the net protein utilization can be raised further to nearly the values for meat and milk protein. A marked improvement in the nutritive value of corn flour can also be accomplished by using 3 per cent fish flour, 3 per cent egg powder, 3 per cent food yeast, 5 per cent skim milk, 8 per cent soya flour or 8 per cent cottonseed flour.3/

15. Such supplements are not only cheaper than synthetic amino acids, but they also have the advantage of improving the total quantity of protein as well as the efficiency of utilization of the protein already present. As progress in synthesizing essential amino acids continues and prices decrease, it should become practical to use synthetic amino acids to improve the quality of the protein in many foods whose protein value is now limited by amino acid deficiencies and imbalances. Such a practice will greatly extend the usefulness of foods of vegetable origin whose protein is partially wasted by the body.

3/ Bressani, R., Marenco, E., and Valiente, A. T., Enrichment of lime-treated corn flour with animal and vegetable proteins and with amino acids, Abstr. Fifth Int. Cong. on Nutrition, Sept. 1-7, 1960, Washington, D.C., p. 59.

Better Yielding and More Nutritious Varieties

16. Great progress has been made in developing higher yielding and more resistant varieties of plants and this is one of the major reasons for the increases in agricultural production in the developed countries. Part of the increase in corn yields in the U.S. and other developed countries is due to the use of hybrid seed, and the higher-yielding varieties of wheat, oats, soya and other basic crops available. Other examples are wilt-resistant peas and cabbages, mosaic-resistant snap beans, virus-resistant potatoes, mildew-resistant cucumbers and lima beans, anthracnose-resistant watermelons, and strawberries resistant to leaf spot and red stele.

17. Progress has also been made in selecting varieties of plants for desirable nutritional characteristics; much more will be possible when serious attention is paid to nutritive value. Cereal grains with higher protein quantity and quality, cottonseed with no gossypol pigment to bind the available lysine during pressing and squash with a high carotene content are among the examples.

18. New breeds of animals have also contributed to the yield per unit of feed and nutritive value of foods of animal origin. Hens have been selected for maximum egg production per unit of feed, dairy cattle for efficiency of meat and milk production and swine for rate of growth and growth per unit of feed. Hogs with more lean meat and less fat, poultry bred and fed for maximum lean meat per unit of total weight, and dairy cattle selected for high butterfat content of milk have been in regular commercial production in the U.S. for many years.

New Food Products

19. As the growing population exerts more pressure on the food supplies of most countries, the search for economical and nutritious new sources of food is intensified. Of greatest promise for most tropical countries are combinations of the oilseed meals and cereal grains.[4] The press cakes from soya, cotton, sesame, sunflower, and peanut contain approximately 50 per cent protein and are relatively low priced because part of the cost of production is met by selling the oil. When combined with about two-thirds of a cereal grain, the oilseed meals give a dry food containing about 25 per cent protein of a quality approaching that of proteins of animal origin.

20. The addition of a small amount of yeast and either a leaf meal or synthetic vitamin A gives a highly nutritious basic food. This is the principle used in the development of low cost vegetable mixtures by the Institute of Central America and Panama. Some of these are already being manufactured under the generic name Incaparina and are sold as new basic foods in eight Latin American countries.

21. This food which contains 38 per cent cottonseed flour, 3 per cent torula yeast, either 3 per cent leaf meal or synthetic vitamin A, 1 per cent calcium carbonate and the remainder corn, sorghum, rice, wheat or other cereal is effective in the treatment of severe protein malnutrition in children and produces a nitrogen retention similar to that of milk in young children fed at a level of 2 to 3 gm. of protein per kg. per day.[5] Almost any region has either the raw materials for such a mixture or the potentiality of growing them.

4/ Scrimshaw, N. S., and Bressani, R., Vegetable protein mixtures for human consumption, Fed. Proc., 20 (Supple. No. 7), 80-88 (1961).

5/ Scrimshaw, N. S., Behar, M., Wilson, D., Viteri, F., Arroyave, G., and Bressani, R., All-vegetable protein mixtures for human feeding. V. Clinical trials with INCAP mixtures 8 and 9 and with corn and beans, Am. J. Clin. Nutrition, 9, 196-205 (1961).

22. Much interest has been expressed in the possibility of using isolated protein from cereal, legumes or oil seeds for human feeding but they seem likely to remain too expensive to be of practical importance in the near future. In areas with abundant coconuts, the protein of copra can be advantageously used in foods for human consumption. Food yeast has value as a supplementary source of B-complex vitamins and also contributes useful protein. Unfortunately it can only be consumed in relatively small amounts without gastrointestinal distress from excessive gas.

23. Work has been done on the isolation of grass protein and green one-celled algae of the chlorella type, molds and bacteria grown in liquid culture have all been proposed for food but no one has yet succeeded in making these preparations palatable for large scale consumption. Preliminary estimates of nutritive value and cost have also been disappointing.

24. There is no doubt that increased quantities of fish and other sea food can be made available, particularly with modern refrigeration and frozen storage. Often the costs are beyond the means of large segments of the population of technically underdeveloped areas. Another means of increasing the availability of protein from fish is the more widespread use of freshwater fish ponds.

25. The proposal that has seemed most attractive, however, is the production of fish flour, using whole fish and particularly fish which would otherwise have little commercial value. Several processes have been developed and put into operation.

26. Thus far only foods from natural sources with or without the use of synthetic nutrients to improve them have been mentioned. The essential nutrients required by man are all chemical substances for which almost all the formulas are known. Most of them can already be synthesized or produced microbiologically but often only at an exhorbitant cost.

27. It seems certain that soon partially and even wholly synthetic foods will be competing in both palatability and nutritive value with foods of natural origin. Indeed, considering the use of artificial flavors and colors, hydrogenated fats, enrichment with synthetic nutrients, emulsifying agents and the like, this process has already begun.

Food Safety

28. In the development of agricultural and food programs the safety of the food supply must be a primary concern. The increasing and necessary use of chemicals at all stages in the production and handling of foods is accompanied by hazards as well as advantages. Each new substance has potentially harmful as well as beneficial effects and the consumer must be protected from undesirable effects without discouraging or restricting the use of chemicals in ways that are beneficial.

29. Potentially hazardous materials enter the food chain not only by their intentional use in foods but also as unintentional food additives such as traces of pesticide, antibiotic and hormone residues, detergents used in cleaning containers, strontium 90 from radioactive fallout and many others.

30. A frequently overlooked fact is that most plants used for food by man already contain substances known to be toxic but the effects are minimized by conventional methods of handling them. Important among these are the trypsin inhibitor of raw soybeans which impairs protein digestion; the hemaglutins in many common legumes; the goiterogenic substances in plants of the cabbage family and in several common legumes; the potentially lethal cyanides of manioc (cassava or yucca); the cyanogenetic glucoside in the lima bean (Phaseola lunatus); the hypoglycin of the ackee fruit; gossypol and possibly other toxic materials in cottonseed meal; the active material of the broad bean (Vicia faba) which causes hemolytic anemia; the active principle in Lathyrus satirus responsible for lathyrism; and the high concentrations of oxalates in many common vegetables. In areas where these are commonly used, the harmful effects are minimized by cooking or other conventional methods of processing and consuming them. When they are

introduced into a new population, however, caution must be exercised to assure their safe use.

31. Methods of harvesting and storage of crops have also been shown to be important in the contamination of otherwise safe sources of food. Several instances of widespread toxicity have been the result of improperly stored grain and legumes which become moldy. The toxic agents in these cases were compounds produced by the molds which remained active throughout the various processing procedures. Thus it is important that the agricultural products used in foods be kept free from adverse effects of fungal as well as bacterial contamination.

32. Recognition of the problem of protecting the food supply in the U.S. is based on the concept that there are no harmless substances, but only harmless ways of using them. Until the compounds have specifically been shown to be safe, it is assumed that there is potential hazard from any chemical intentionally added, such as coloring and flavoring agents, anti-caking agents, emulsifiers, etc. The potential risk presented by such non-intentional additives as pesticide residues, antibiotic and hormone residues, detergents used in processing plants, materials migrating into foods from packaging materials, and strontium 90 and iodine 131 from radioactive fallout must be similarly evaluated. Again, in all specific instances the hazards must be recognized and appropriate measures taken to avoid contamination, remove the contaminant, or establish a tolerance level at which the contaminant may be present without danger.

33. The foregoing considerations make necessary continuing research in food toxicology, international exchange of information and standardization of food control regulations. WHO and FAO have already made considerable progress in this direction by convening a series of joint conferences and expert committees. FAO also issues summaries of food additive control regulations in various countries and a periodic bulletin listing new regulations introduced in any country. Each country must make provision for guarding the safety of its food supply in regard to food additives just as arrangements are now made for assuring the bacteriological purity and the safety of public water supplies.

Changing Agricultural Practices and Food Habits

34. The introduction of higher yielding and more nutritious food crops, the initiation of modern agricultural practices, improvements in methods of food conservation, the development and use of new protein-rich foods, and achieving better dietary habits all require changes in long established customs and attitudes of people. Even with the help of social scientists, educators and government officials, this is not easily achieved.

35. Some cultures are proving relatively receptive to change; others are extraordinarily resistant. It is beyond the scope of this paper to discuss the ways in which cultural change is brought about but other papers presented in this meeting by social scientists place special emphasis upon it.

36. Action at a national level can sometimes be highly effective in the introduction of improved agricultural practices and food habits. Governments can help by making available such tools of change as improved seeds and animal varieties, agricultural chemicals, appropriate implements and machinery, storage and marketing facilities, agricultural credit and the like. For example, large investments are required in chemical fertilizer plants throughout the less developed areas; frequently these need to be provided or underwritten by national governments. Adequate rural credit at reasonable interest rates for the right kind of agricultural development is also of crucial importance. Sometimes a subsidy may be necessary to get a new crop or industry started or import restrictions may help national production to get a foothold.

37. Taxation policies relating to the importation of agricultural machinery, the purchase of parts for maintenance and of fuel may encourage or stifle its use. National planning councils, which have now been established in the majority of developing countries, need to be aware of necessary changes in agricultural and

food practices to meet the nutritional needs of their growing populations and to promote these in an orderly, rational manner.

38. Too often attention has been focused on major construction projects although these will not in themselves solve the problems of developing countries. Sometimes the objective seems to be the achievement of specific material evidences of progress. Roads, school and public buildings, dams and refineries are useful and necessary but they should not be ends in themselves.

39. Human needs should be the basis for formulating priorities and arriving at decisions as to the use of limited resources. Countries are not underdeveloped because they do not have the material evidences of progress but because they do not have the trained manpower to create them and maintain them without outside help. It is knowledge and know-how, and not primarily natural resources, which give the people of the highly developed countries of the West such a high standard of living and general welfare.

40. Education and training for all levels of the population are necessary to ensure that the developing countries come to share the benefits of scientific and technical knowledge. Programs of education and training need to be given first priority. Every country needs persons who are sufficiently well trained in nutrition and food science to adapt existing knowledge to the special needs and circumstances of their people. All need personnel who are well trained in agricultural extension and health education to teach others to apply this knowledge. Persons in developing countries must be taught to run and service agricultural and industrial machinery. Basic to the technical development of a country is a sufficient number of adequately trained primary school, secondary school and university teachers for its educational needs.

41. Effective government support of measures to improve agricultural and food practices is likely to come about only when the administrative officials and political leaders of a country themselves become aware of the true needs and possibilities for technical development. Government officials must understand the basic facts of science and technology if their economic and political decisions are to be the right ones.

42. Some personnel must also be devoted to research, in order to look for solutions to those problems for which ready solutions are not available from experience elsewhere. Moreover, no matter how much knowledge is available there is always need for more.

43. Lasting improvements in food and agriculture require technical knowledge to be disseminated throughout a society. It is the present strength of the so-called developed countries that they have achieved this to a considerable degree although the educational effort is a continuing one. The great hope and promise for the future of the underdeveloped countries is that they too can share in this knowledge and that they have both the human and natural resources to utilize it for the benefit of their peoples.

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